ISD
Project Monitoring & Control
(PMC)

Number: 580-PC-012-01
Effective Date: February 1, 2005
Expiration Date: February 1, 2009

Approved By: (signature)
Name: Joe Hennessy
Title: Chief, ISD

Responsible Office: 580/Information Systems Division (ISD)
Title: Project Monitoring & Control (PMC)

Asset Type: Process
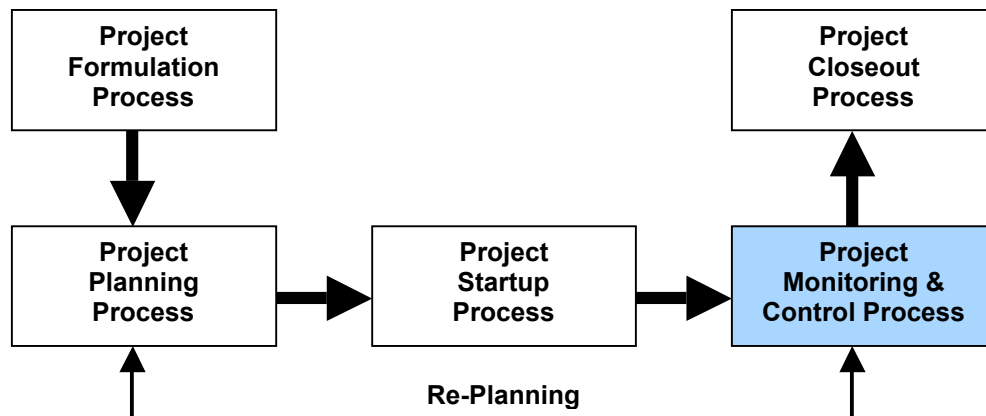**PAL Number:** 1.4

Purpose	This document establishes the process for Project Monitoring and Control (PMC) for all ISD mission software.
	PMC is performed to provide understanding and insight into the project's progress so that appropriate corrective actions can be taken when the project's performance deviates significantly from the plan. Aspects of a project's progress include interfaces to other organizations, deliverables, schedules, cost, effort, risk, reviews, verification, validation, and amount of supporting services. Planned management of these aspects is captured in one or more software and/or system plans.
Scope	This document provides the basic PMC process and requirements for the life cycle of mission software.
Context Diagram	

Software Project Management Processes

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Roles and Responsibilities	**Product Development Lead (PDL):**
	Responsible for project safety, cost, schedule, & technical performance
	Develops a cooperative and performance-oriented team
	Ensures that products and services from the project meet customer needs
	Development Team Lead (DTL)
	Responsible for products produced by the team
	Produces consolidated status reports from the team
	Review Team
	Responsible for review of designated products, project progress, and project specific areas
	Software Developer
	Produces product elements and related status reports on work progress
Usage Scenario	**Primary Usage Scenario:**
	This process starts as soon as the project starts. The process is ongoing during the whole project life cycle.
Inputs	**Primary Usage Scenario:**
	Baselined SMP/PP and subsidiary plans
	Established development environment
	Initial progress tracking worksheet
	Project status information
	Technical review materials
	❖ Review packages
	❖ Change Requests
	❖ Requests For Action (RFAs)
	❖ Review Item Dispositions (RIDs)
	❖ Impact Analysis (for Requirements changes), Etc.
Entry Criteria	**Primary Usage Scenario:**
	This process starts as soon as the project starts. Ideally, one should have access to the following inputs as a minimum for PMC startup:
	Baselined Software Management Plan/Product Plan (SMP/PP) and subsidiary plans
	Initial progress tracking worksheet
Exit Criteria	**Primary Usage Scenario:**
	Only two events can end the operation of this process:
	The project stops when an Abort/Suspend order has been issued.
	OR
	The project reaches "End-of-Mission".

Outputs	**Primary Usage Scenario:**
	Project Status Reports
	Issues
	Lessons Learned
	PMC Risk Information
	Requests For Action
	Review Item Disposition
	OR
	None, if Abort/Suspend order is received.

Major Tasks	The **PDL** shall perform continuously:

1. Monitor project activities and resources
2. Monitor work products and project data
3. Monitor software acquisition
4. Monitor commitments

The **PDL** shall perform as needed:

5. Manage corrective actions
6. Generate reports and review progress
7. Conduct milestone reviews
8. Document lessons learned

Task 1	**Monitor project activities, resources, and personnel (PDL)**

a) Monitor progress against the schedule by periodically measuring actual completion of activities and milestones.

Compare this progress against the planned documented schedule.

Identify significant deviations and trends.

b) Monitor the project's cost and effort by periodically measuring actual cost and effort expended by project staff.

Compare the cost and effort to the planned documented estimates.

Identify significant deviations and trends.

c) Monitor resources provided and used by the project.

Compare the resources to the planned documented estimates.

Identify significant deviations and trends.

d) Monitor documented risks in the context of the project's current status and circumstances.

If project circumstances change which could give rise to new risk(s), then send relevant information (PMC Risk Information) to the ISD Software Risk Identification sub-process.

Revise the documentation on risks as additional information becomes available to incorporate changes. Communicate risk status to those affected. See ISD Software Risk Monitoring and Control sub-process for full details.

Task 1 continued on next page

Task 1	**Monitor project activities and resources**	**(PDL)**

(Continued)

e) Monitor project personnel training schedule by periodically measuring the progress of scheduled training.

Compare actual training against the planned documented training

Identify and document significant deviations and trends.

GUIDANCE: Monitoring typically involves measuring the actual values of the SMP/PP (i.e. completion rate of software elements, resource utilization, etc.) comparing actual values to the estimates in the plan, and identifying significant deviations. Examples of resources, Task 1c, include:

Development and Test Environment

Safety and Security Environments

Network capacity

Manpower usage and training

Processor (CPU) and memory usage

Process usage and improvement

Facility development

Task 2	**Monitor work products and project data**	**(PDL)**

a) Monitor the project's work products and tasks by periodically measuring the actual characteristics of the work products and tasks, e.g. size, complexity, quality, security, etc.

Compare the actual characteristics and the changes to the characteristics to estimates documented in the SMP/PP.

Identify significant deviations and trends.

b) Monitor data management activities against the description in the SMP/PP on a periodic basis.

Identify significant issues and their potential impacts.

Document the results from the data management monitoring.

GUIDANCE: Some examples of project data covered includes: Source code & related files, Meeting minutes, Metrics, Project documentation, Telemetry, Test scripts, Input data, Science data, Safety & security backup plans, etc.

| **Task 3** | **Monitor software acquisition** | **(PDL)** |

Monitor the project's acquisition of software by periodically performing the following as needed:

a) Reviewing the needs of the project for new acquisitions of software.

b) Initiate Requests-for-Proposal (RFPs) to satisfy identified needs.

c) Prepare or update contracts to acquire software.

d) Monitor suppliers for compliance with contract provisions, on-time software delivery, and quality of software to be delivered.

e) Monitor acceptance of software that is delivered to assure full compliance with acceptance processes and quality requirements.

GUIDANCE: See the Software Acquisition process for details.

| **Task 4** | **Monitor commitments** | **(PDL)** |

a) Monitor internal and external commitments against the plan.

b) Monitor the status of stakeholder involvement against the plan.

c) Identify those commitments that have not been satisfied or those that are at significant risk of not being satisfied.

d) Document the results of these reviews.

GUIDANCE: Some examples of these types of commitments include:
Deliverables
Interface Control Documents (ICDs)
Interface Requirements Documents (IRDs)
Engineering Test Units (ETUs)
Requests for Action (RFAs)
Review Item Dispositions (RIDs)
Simulator availability
Staff from other organizations

Once the stakeholders are identified and the extent of their involvement within the project is specified in the SMP/PP, that involvement must be monitored to ensure that the appropriate interactions are occurring with the appropriate stakeholders.

Task 5	**Manage corrective actions**	**(PDL)**

a) Gather issues for analysis developed during previous tasks or input from other processes.

b) Analyze issues to determine need for corrective action. Document the analysis and appropriate actions needed to address the identified issues.

c) Review and get agreement with the relevant stakeholders on the actions to be taken and the priority to be assigned for their completion.

d) Negotiate changes to internal and external commitments.

e) Monitor the corrective actions for completion

f) Analyze results of corrective actions to determine their effectiveness. If previous corrective actions did not produce the desired result, then return to step b) above to rework the issues involved.

GUIDANCE: Issues are collected from reviews and the execution of other processes. Examples of issues to be gathered include:

> *Issues discovered through performing product development, maintenance, reviews, execution of other processes, verification and validation activities*

> *Significant deviations in schedule, cost, staffing, quality, product size, requirements, risk, etc. from the estimates in the SMP/PP.*

> *Commitments (internal and external) that have not been satisfied.*

> *Significant changes in risk status.*

> *Data access, collection, privacy, safety, and security issues.*

> *Stakeholder representation or involvement issues.*

> *Change Requests, Impact Analysis (for Requirements changes)*

> *Requests For Action*

> *Review Item Dispositions*

Task 6	**Generate reports and review progress**	**(PDL)**

a) Assemble project measures and the identified significant deviations and trends from what was planned in the SMP/PP.

b) Use the data to generate Metrics Reports.

c) Produce project status report (that includes the Metrics data).

d) Communicate status on assigned activities and work products to relevant stakeholders, including project, line management, and the project team.

e) Review the results of collecting and analyzing measures for controlling the project with relevant stakeholders.

f) Identify and document significant issues and action items resulting from these project progress reviews.

g) Track action items and issue resolution to closure.

GUIDANCE: Data that should be included in the report: progress tracking data, schedule, risk, cost, effort, software error rates including severity, testing results, deficiency report (DR) summary, issues, etc.

Task 6	**Generate reports and review progress**	**(PDL)**

(continued)

Examples of progress reviews include the following:
> *Reviews with the project team*
>
> *Reviews with project management and suppliers*
>
> *Reviews with line management*
>
> *Reviews with customers and end users*

Stakeholders include managers, project team, customers, end users, suppliers, and others affected within the organization. Include these stakeholders in reviews as appropriate.

Task 7	**Conduct milestone reviews**	**(PDL)**

a) Conduct the reviews at meaningful points in the project's schedule with relevant stakeholders.

b) Review the commitments, plan, status, and risks of the project.

c) Collect and document significant issues and their impacts as Review Item Dispositions (RIDs) and Requests For Action (RFAs).

d) Assign RIDs/RFAs for corrective action to the appropriate process

e) Track action items and issues to closure.

GUIDANCE: Milestone reviews are planned during project planning and are typically formal reviews.
> Software Requirements Review *(SRR)*
> Software Preliminary Design Review *(PDR)*
> Software Critical Design Review *(CDR)*
> Acceptance Test Readiness Review *(ATRR)*
> Operational Readiness Review *(ORR)*

See checklists at http://software.gsfc.nasa.gov/process.htm for details.

Stakeholders include managers, staff members, customers, end users, suppliers, and others affected within the organization. Include these stakeholders in milestone reviews as appropriate.

Task 7d example: "Assign RIDs/RFAs for corrective action", Requirements change RIDs/RFAs would be assigned to the Requirements Management process

Corrective action is required when the issue may prevent the project from meeting its objectives if left unresolved. Examples of potential actions include the following:
> *Modifying the statement of work*
> *Modifying the requirements*
> *Revising estimates and plans*
> *Renegotiating commitments*
> *Adding resources*
> *Changing appropriate processes*
> *Revising project risks*

| Task 8 | **Document lessons learned** | **(PDL)** |

a) Collect and document issues that are found to have had a significant positive or negative impact on the project. If possible provide a suggestion for improvement to processes.

b) Submit these significant issues (Lessons Learned) to the GSFC Engineering Process group for distribution to relevant stakeholders.

GUIDANCE: Lessons Learned are those significant issues encountered during a project that have affected, either positively or negatively, the schedule, cost, effort, staffing, quality, product size, requirements, risk, required resources, commitments, training, stakeholder involvement, processes, etc.

To view previous Lessons Learned or to submit a new one go to the GSFC web site http://software.gsfc.nasa.gov/lessons.htm*.*

Measures

Recommended Measures:

Resource Use (planned versus actual)

Commitments (both internal and external)

Project Risks (status of current as well as possible new)

Training for project personnel (planned versus actual)

Stakeholder involvement (planned versus actual)

Required Measures are found in "**In-House Development and Maintenance of Software Products**", GPG 8700.5, at http://gdms.gsfc.nasa.gov/gdms

Schedule (planned versus actual)

Budget (cost and effort)

Product size

Product error information

Tools and Templates

Name	Description
Action Item Tracking Tool	Tracking and maintaining status
Earned Value Tool	Excel-based workbook tool available at http://software.gsfc.nasa.gov/process.cfm.
Microsoft Project Tool	Tool for tracking schedule available as COTS software from Microsoft Corp.
Risk Tracking Tool	Tracking and maintaining status

Training

Course Name	Description
Earned Value	Earned Value strategies and methods for the first time user of the Excel-based workbook tool. For more details see: http://software.gsfc.nasa.gov/training.htm
Foundations of Project Management	FPM provides interesting and relevant instruction of the methodologies, techniques, terms and guidelines used to manage cost, schedules and technical aspects through the life cycle of a project. The course is invaluable for project control and support personnel who need a better grasp of the project world. For more details see: http://ohr.gsfc.nasa.gov/DevGuide/Home.htm
Quantitative Software Management	A two-day course developed at JPL and taught by Jairus Hihn & Bill Decker. Contains GSFC-specific information. Course materials include lecture presentations, tools, spreadsheets, and supporting information. Individual presentations, tools, etc. can be accessed from the web page address provided. For more details see: http://software.gsfc.nasa.gov/training.htm
Risk Management	This 2-day course familiarizes the student with the fundamentals of Continuous Risk Management (CRM) and provides for interactive learning through the use of various methods and tools and a hypothetical space flight project case study. The second day is dedicated to organization-specific activities that will:1)establish and organization-specific risk baseline; 2)practice the functions of CRM paradigm: 3) promote teambuilding and a more cohesive work environment: 4) provide risk information that can be acted on immediately upon completion of the course. Emphasis can be placed on the creation of Risk Management Plan as deemed necessary by each organization. For more details see: http://ohr.gsfc.nasa.gov/DevGuide/Home.htm
Software Project Management	The Software Project Management Course is a 5-day, residential, intermediate project management course targeted at those interested in increasing their knowledge of systems and software. Attendees should have some experience in managing projects. The course provides an overview of project management and associated topics. Classroom activities are augmented by hands-on workshops and group projects (e.g., project management plans, earned value, risk management, cost/schedule/ technical performance monitoring). For more details see: http://software.gsfc.nasa.gov/training.htm

Training   (Continued)

Course Name	Description
Technical Manager's Training	The TMT is a 6-day residential program that focuses on presenting a high level overview of how work gets done in the Goddard environment. The Course Objectives are to: a) Learn about the Life Cycle of a project within the Goddard environment b) Get familiar with principles of good Project Management, (How to plan, organize, implement, and control technical projects) and c) Learn principles of how to increase effectiveness within work teams through collaborative team participation. There is a two-hour orientation at Goddard Greenbelt, 6 full days at Wallops and an hour and a half wrap-up session the following week in Goddard Greenbelt. The course begins on a Sunday and ends on a Friday. Developmental activities begin on the bus ride to Wallops.

References

Glossary: http://software.gsfc.nasa.gov/glossary.cfm
Defines common terms used in ISD processes

ETVX Diagram: Link to the ETVX diagram for this process

Process Asset Library: http://software.gsfc.nasa.gov/process.cfm
Library of all ISD process descriptions

In-House Development and Maintenance of Software Products,
GPG 8700.5, at http://gdms.gsfc.nasa.gov/gdms

NASA Software Engineering Requirements,
NPR 7150.x, at http://gdms.gsfc.nasa.gov/gdms

The latest versions of the following can be found in the Process Asset Library at http://software.gsfc.nasa.gov/process.cfm

ISD Software Risk Identification

ISD Software Risk Monitoring and Control

Software Requirements Review (SRR) Checklist

Software Preliminary Design Review (PDR) Checklist

Software Critical Design Review (CDR) Checklist

Acceptance Test Readiness Review (ATRR) Checklist

Operational Readiness Review (ORR) Checklist

Quality Management System Records

Controlled Document/Description	Record Custodian
Software Management Plan/Product Plan (SMP/PP) – signed and dated by the Branch Head, Software Manager, and Customer. ISD CCB approval is only required if the plan is not subject to Project CM.	Software Manager

Development History	Version	Date	Description of Development Changes
	0.1	June 10, 2004	Created initial draft of the PMC process PGArnold
	0.2	July 9, 2004	Updated draft based on feedback from reviewers PGArnold
	0.3	July 23, 2004	Additions for integration with other processes PGArnold
	0.4	July 30, 2004	Final comments incorporated PGArnold
	0.6	Sept 22, 2004	Changes to address comments from CCB. PGArnold

Change History	Version	Date	Description of Improvements
	1.0	Jan. 26, 2005	Initial approved version by CCB

ISD Project Monitoring and Control (PMC) ETVX* Diagram

Number: 580-ED-012-01
Effective Date: October 1, 2004
Expiration Date: October 1, 2009

Approved By: (signature)
Name: Joe Hennessy
Title: Chief, ISD

Responsible Office: 580/Information Systems Division (ISD)
Title: PMC ETVX Diagram

Asset Type: ETVX Diagram
PAL Number: 1.4

Inputs	Entry Criteria	Major Tasks	Exit Criteria	Outputs
Baselined SMP/PP & subsidiary plans	Availability of following:	1. Monitor project activities and resources	Project is completed & accepted	Project Status Reports
Established development environment	Baselined SMP & subsidiary plans	2. Monitor work products and project data		Issues
Required training schedule		3. Monitor software acquisition		Lessons Learned
Initialized Progress Tracking Worksheet	Initialized Progress Tracking Worksheet	4. Monitor commitments		PMC Risk Information
Project Status Information		5. Manage corrective actions		
Technical review materials		6. Generate reports and review progress		Review Item Dispositions
		7. Conduct milestone reviews		Requests for Action
		8. Document lessons learned		
			OR	
			Project aborted or suspended	
		Verification and Validation Objectively evaluate adherence of PMC & work products to requirements, objectives, and standards. Review status with higher-level management & resolve issues.		

Development History	Version	Date	Description of Development Changes
	0.1	April 17, 2004	Created initial version of the PMC ETVX Diagram PGArnold
	0.2	June 15, 2004	Incorporated comments from reviewers. PGArnold
	0.3	June 24, 2004	Updates due to comments on process and the changes that resulted in the ETVX. PGArnold
	0.4	July 9, 2004	Updated ETVX to conform to changes in process. PGArnold
	0.5	July 23, 2004	Additions for integration with other processes PGArnold
	0.6	Sept 22, 2004	Changes to address comments from CCB. PGArnold

Change History	Version	Date	Description of Improvements
	1.0	Jan. 26, 2005	Approved by the ISD CCB